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THE MARITIME NATION OF JAPAN

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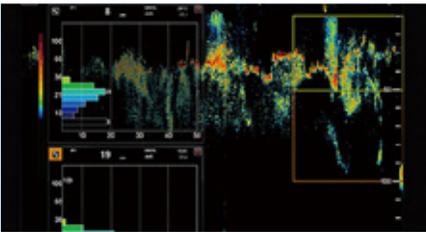
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Land of Mountains, Forests, Valleys and Caves

THEME FOR **APRIL:**

THE MARITIME NATION OF JAPAN

In this month's Feature, we take a look at some of the myriad ways in which Japan respects, protects, makes use of and enjoys its rich marine environment, beginning with the policies laid down by the national government.



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ON THE COVER
The Maritime Nation of Japan
Photo: Courtesy of MH21 Research Consortium

JAPAN-CHILE SUMMIT MEETING

ON February 23, 2018, Shinzo Abe, Prime Minister of Japan, held a summit meeting with H.E. Ms. Michelle Bachelet Jeria, President of the Republic of Chile, who was making an official working visit to Japan.

Prime Minister Abe mentioned that various exchanges took place last year, which marked the 120th anniversary of the establishment of Japan-Chile diplomatic relations, including the visit to Chile by Their Imperial Highnesses Prince and Princess Akishino, and activities by Chile's Nikkei community. Prime Minister Abe noted that by elevating the relationship between Japan and Chile to a "strategic partnership," he intends to further deepen cooperation between the two countries and in the international arena through fora such as "policy dialogues" for discussing the bilateral relationship and various challenges in the international arena. Furthermore, Prime Minister Abe stated that Japan is scheduled to dispatch a defense attaché to Chile from 2019, and expressed expectation that a cooperative relationship will be promoted in the defense field.

In addition, with regard to the economic field, the two leaders welcomed further progress with the two countries' economic relationship through the building of economic frameworks, including the Japan-Chile Economic Partnership (EPA) that entered into force in 2007 and the tax convention



Japanese and Chilean delegates at the Japan-Chile summit meeting

that took effect in 2016.

Prime Minister Abe mentioned the successful progress being made with the KIZUNA Projectⁱ, a cooperative project in the disaster reduction field, and stated that the target for the number of people to be trained by 2020 will be doubled from 2,000 to more than 4,000. In addition, the two leaders also welcomed that the Japan-Chile Partnership Program (JCPP)ⁱⁱ 2030, a memorandum on trilateral cooperation, is now set to be signed.

In response, President Bachelet introduced activities relating to the 120th anniversary of the establishment of diplomatic relations between the two countries, and stated that she intends to further advance cooperation in the defense field and the trade and investment field, as well as trilateral cooperation between Japan and Chile, including in the disaster reduction field. Furthermore, President Bachelet expressed gratitude for Japan's support at the time of the forest fires in Chile in 2017, along with stating that she hopes to cooperate to realize the United Nations' 2030 Agenda for Sustainable Development.

In addition, the two leaders welcomed that a working holiday scheme will begin operating on February 23, that a memorandum of cooperation in the sports field is now set to be signed, and that a substantial agreement was reached on an agreement concerning driver's licenses, and shared the view that they will advance exchanges between citizens in a variety of fields.

With regard to cooperating on regional affairs, including the North Korea issue, and in the international arena, including UN Security Council reform, the two leaders shared the view that the cooperative relationship will be deepened. In addition, the two leaders confirmed cooperation in the run-up to the Asia-Pacific Economic



Prime Minister Abe shakes hands with H.E. Ms. Michelle Bachelet Jeria, President of the Republic of Chile.

Cooperation (APEC) meeting that will be held in Chile in 2019. Furthermore, as Japan and Chile are both maritime nations, the two leaders discussed the importance of a free and open maritime order. In addition, Prime Minister Abe explained the "Free and Open Indo-Pacific Strategy," and the two leaders shared the view that they will continue the discussion.

With regard to the North Korea issue, Prime Minister Abe explained that it is necessary to maximize pressure on North Korea, and he also expressed expectation of understanding and cooperation for promptly resolving the abductions issue. In response, President Bachelet mentioned that she will visit Nagasaki during her stay in Japan, explained that Chile has a firm position that is opposed to proliferation and to North Korea's nuclear development program, and has consistently cooperated with Japan. The two leaders shared the view that they will coordinate closely.

- i Officially known as the "Disaster Risk Reduction Training Program for Latin America and the Caribbean in Chile" (March 2015-March 2020), a technical cooperation project. The project trains personnel for contributing to disaster prevention in countries in Latin America and the Caribbean through trilateral cooperation that includes dispatching specialists from Japan to hold disaster prevention training in Chile. A target of training 4,000 people during the five-year cooperation period has been set.
- ii Japan and Chile work together on cooperation with other developing countries (so-called trilateral cooperation). An agreement document was concluded in June 1999. Thus far, third-country training and specialist dispatches to third countries have been implemented in fields such as disaster prevention and the environment, fisheries and medical care.

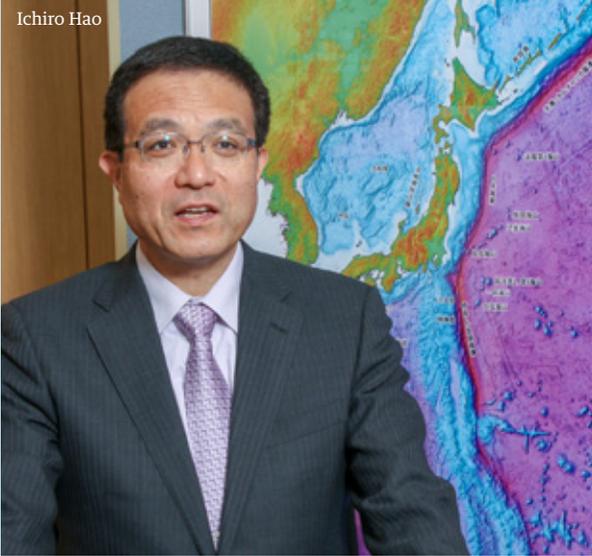
The Maritime Nation of Japan

Regarding the 3rd Basic Plan on Ocean Policy, which is due to be formulated this spring, Ichiro Hao (pp. 6-7), Director General of the National Ocean Policy Secretariat, Cabinet Office, notes that Japan will “fully take into account factors such as recent environmental changes and threats in the oceans surrounding Japan, progress with initiatives aimed at creating open and stable oceans based on the rule of law ... and to guarantee safety and peace of mind for the people of Japan, and safeguard the country’s marine interests.” In this month’s Feature, we deep dive these and other issues confronting Japan as a maritime nation, including the quest for subsea energy resources, coast guard training, sustainable fishing technologies past and present, and territorial sovereignty.

Courtesy of Furuno Electric Co., Ltd.

Promoting Ocean Policy

Ichiro Hao



JAPAN has always protected and made the most of the sea that surrounds it. Amidst changes in the country's marine environment, Japan set out the Basic Act on Ocean Policy in 2007 and released a Basic Plan in March 2008. Ten years on, we asked Ichiro Hao, Director General of the National Ocean Policy Secretariat, Cabinet Office about the 3rd Basic Plan on Ocean Policy.

It has been ten years since the Basic Act on Ocean Policy came into effect. What was the background to the Act and what was its purpose?

The enactment of the Basic Act on Ocean Policy was prompted by a whole host of ocean-related issues that were becoming apparent at the time. The ocean was playing an increasingly key role in securing food, resources and energy, transporting cargo, and maintaining the environment, for example. Other issues included contamination of the marine environment, declining fishery resources, and a string of incidents that could potentially impact on Japan's marine interests.

The Basic Act on Ocean Policy outlined guiding principles on ocean-related matters, and set out the foundations for ocean policy, including the formulation of the Basic Plan on Ocean Policy. It also specified the establishment of the Headquarters for Ocean Policy, headed by the Prime Minister, with the aim of comprehensively and systematically addressing ocean policy across all government ministries and agencies.

I work for the National Ocean Policy Secretariat, Cabinet Office which was set up to bring all of these areas together within the government and push full steam ahead.

What have been the key points in ocean policy over the last decade?

The 2nd Basic Plan on Ocean Policy was formulated in 2013. It set out a number of priorities aimed at establishing Japan as a maritime country, including "International cooperation and contribution to international community," "Wealth and prosperity through ocean development and utilization of the sea," "From a country protected by the sea to a country that protects the sea," and "Venturing into the unexplored frontier."

We have continued to work on a raft of measures in the maritime sector over the last ten years. In addition to filing a request to extend Japan's continental shelf, to cover the vast expanse of ocean that comprises roughly half of the country's territory, relevant legislation such as the Act on Punishment of and Measures against Acts of Piracy, the Act on the Preservation of Low-Water Line, and the Act on the Conservation of Remote Islands and Sustainability of Remote Islands' Community have also been enacted.

In December 2017, the Advisory Council for the

National Headquarters for Ocean Policy compiled a report on the 3rd Basic Plan on Ocean Policy, which is due to be formulated in spring 2018.

What were the main points in that report?

Based on evaluation of progress under the 2nd Basic Plan on Ocean Policy, the report recommended that recent changes in Japan's maritime situation should be taken into account when formulating the 3rd Basic Plan on Ocean Policy. In particular, the report stressed the need to fully take into account factors such as recent environmental changes and threats in the oceans surrounding Japan, and progress with initiatives aimed at creating open and stable oceans based on the rule of law. The report also recommended that the existing Basic Act on Ocean Policy be fundamentally restructured, to encompass maritime security on a broader scale, and that proactive measures be taken to guarantee safety and peace of mind for the people of Japan, and safeguard the country's marine interests.

Another area covered in the report was scientific knowledge. That includes taking steps to expand marine resource development and offshore wind power in order to ensure stable supplies of resources and energy, using international frameworks to preserve the marine environment and enable comprehensive management of coastal areas, and securing and developing human resources to establish Japan as a maritime country. The report recommended making plans to push full steam ahead with measures such as these over a five-year period, alongside other measures such as international cooperation and arctic policy.

To implement measures set out in the Basic Plan on Ocean Policy effectively and efficiently, the report recommended stepping up processes to reliably verify, evaluate and review implementation and progress based on process management (PDCA cycle), and advised using easy to understand wording to help members of the public to understand.

The government is currently looking into formulating the 3rd Basic Plan on Ocean Policy based on this report.

International cooperation is likely to play a key role in implementing the Basic Plan on Ocean Policy. What would you consider to be the key points in that respect?

The oceans are governed by international rules that have long been debated and acted upon by many countries around the world, most notably the United Nations Convention on the Law of the Sea. The first key point is that countries comply fully with these rules, and establish the rule of law at sea. Maintaining and reinforcing order on the seas through international cooperation, in a free and open manner in accordance with these rules, will in turn enable us to establish a more peaceful and stable international community.

At the same time, there are still numerous maritime issues on a global scale where cause-and-effect are not entirely understood, including global warming. That is why we need to adequately monitor conditions across the oceans, and have a thorough understanding of relevant phenomena. As well as actively contributing to the establishment of a comprehensive oceanographic observation network, based on international cooperation and coordination, it is also important that Japan works to acquire further scientific knowledge through observation, and uses that knowledge to implement rational policies. Implementing measures based on scientific knowledge will be another key point for the future.

From the standpoint of the Basic Plan on Ocean Policy too, I would say that we need to establish these two key points as universal standards throughout the international community, as well as in Japan. ▮

Interview by HITOSHI CHIBA



Energy Resources from the Bottom of the Sea

Research is underway into the commercialization of natural methane hydrate believed to exist in the seabed layer in the waters surrounding the Japanese archipelago.



TAKASHI SASAKI

METHANE hydrate, a substance resting in Japanese coastal waters also known as “burning ice,” has attracted attention in recent years. Methane hydrate is an offshore resource containing methane, the primary component of natural gas, and is believed to exist in the subsea strata 500 meters or deeper under the waters surrounding the Japanese archipelago. As

methane characteristically releases roughly half the amount of carbon dioxide of coal when burned, it is expected to be used as a source of energy for city gas, power generation and fuel cells. The Japan Oil, Gas and Metals National Corporation (JOGMEC) is conducting research and development into methane hydrate’s potential to become a new energy resource as a member of MH21, Research Consortium for Methane Hydrate Resources in Japan.

“Methane hydrate is one of the clathrate hydrates, a type of solid where a guest molecule is trapped

All photos: Courtesy of MH21 Research Consortium

MH21 successfully extracted methane hydrate from the seabed off the coasts of Aichi and Mie Prefectures in tests conducted in March 2013 on the drillship *Chikyu*—a world first.

Scenes from the second offshore methane hydrate production test

inside a cage of water molecules, and this forms a solid in an environment with low temperature and high pressure. Methane hydrate that has been artificially formed in something like ice, when it is brought close to a flame at ordinary temperatures, the emitted methane ignites and forms a flame, after which only water remains. That's how it gets the name 'burning ice,'" explains Yoshihiro Nakatsuka, Deputy Director of the Field Development team in the Methane Hydrate Research & Development Group at JOGMEC.

Full-scale research and development was started by MH21 in 2001 in response to "Japan's Methane Hydrate R&D Program" published by the Ministry of Economy, Trade and Industry. The effort started with exploring how methane hydrate populates the subsea strata and how to extract the methane, and involved twice conducting land-based production tests in Canada that were conducted in 2002 and 2007-2008. In March 2013, the world's first offshore production test was conducted at the DAINI-ATSUMI Knoll in an area off the coast of Aichi and Mie Prefectures. The test confirmed the production of methane gas for six consecutive days. Then, in April 2017, the second offshore production test was conducted in the same area, verifying methane hydrate production over a period of thirty-six days.

"With the methane hydrate production technique we are using, which is known as the 'depressurization method,' we drill a well under the seabed from a ship on the surface, reduce the pressure (depressurization) by drawing up water inside the well with a pump, and then extract the methane produced from a high concentration of methane hydrate deposit. While oil and natural gas are generally trapped inside hard reservoir rock at a depth of several thousand meters underground, methane hydrate is at a depth of only several hundred meters below the seabed, so it is not time-consuming to drill the well as it is with conventional resources. On the other hand, when you bore a well in oil or natural gas which is

trapped under high pressure, it flows out under its own pressure, but in the case of methane hydrate which exists as a solid inside the ground, it won't dissociate and naturally flow unless changes are made to the temperature and pressure environment. The difficult technical challenge we face is how to dissociate the methane and extract it efficiently," says sub-leader Nakatsuka.

Naturally, the ultimate goal of the methane hydrate development plan is to efficiently produce gas from the methane hydrate under the seabed, transport it to land and commercialize the output.

"We have only taken the first steps in research and development into methane hydrate aimed at its future commercialization. Even in the four years that separated the first and second offshore production tests, we continued to explore technologies that would solve some of the issues identified during the first test and we have made steady progress in R&D, but there are still many challenges to solve. In the years ahead, it will be important to work with the private sector and other entities to solve the issues at hand one at a time," notes Yukinori Takuma, the group's Deputy Director General.

Methane is the primary component of natural gas and is regarded as a clean energy because it releases less carbon dioxide and air pollutants when burned than other fuels such as coal. From a global perspective, the low temperature, high pressure environments under which methane hydrate can exist are not limited to areas underneath the deep sea ocean floor; the substance is also widely distributed in permafrost layers, for instance.

According to estimates made by MH21 based on the results of geophysical surveys, the concentration zones in the Eastern Nankai Trough contain methane hydrate deposits equivalent to around five-and-a-half years of the amount of liquid natural gas imported into Japan (as of 2011). Methane hydrate concentration zones have been confirmed elsewhere in the waters off the coast of Japan, and upcoming research and development aimed at the future commercialization of the resource has attracted a great deal of attention. 



Set Nets for Sustainable Fishing

A sustainable fishing method practiced for centuries by fishermen in Himi City, Toyama Prefecture is now attracting attention around the world.

KUMIKO SATO

FACING the Sea of Japan, Toyama Bay in Toyama Prefecture is one of the foremost fishing grounds in Japan. River water containing abundant minerals and other nutrients flows into the Bay from the Tateyama mountain range and surrounding peaks, creating a plankton-rich marine environment in which fish thrive. Toyama Bay is a submarine canyon that suddenly drops off deeply from the coast. The Tsushima Warm Current (surface seawater) traveling the Sea of Japan northward and the cold inherent water of the Sea of Japan (deep seawater) are layered here. Around 600 varieties of fish and shellfish that live in warm and cold water can be caught

All photos: Courtesy of JICA

in the Bay. The specialties of Toyama Bay include broad velvet shrimps in spring, and red snow crabs and yellowtails from fall to winter. In particular, the yellowtails landed in Himi City located on the northwestern section of Toyama Bay from November to February are known throughout Japan by the brand name “Himi *kan-buri*” (midwinter yellowtails from Himi). They fetch prices more than three times higher than yellowtails landed in other areas in the same season. The reason for their high prices is the method used for catching them, in addition to their good flavor due to abundant fat resulting from their growth in the northern sea and southward migration for spawning.

Traditional set net fishing has been practiced for about 400 years in Himi, which has a well formed continental shelf and attracts many fish in Toyama

- 1 Pulling in the catch
- 2 A fisherman from Himi provides technical guidance on set-net fishing to a trainee from Thailand
- 3 Setting the nets early in the morning
- 4 Trainee fishermen from Thailand help sort the catch.

Bay. Set net fishing is a method of catching only the fish that happen to enter the set nets, without chasing the fish.

“People of Himi refer to yellowtails as gifts from the gods,” says Shingo Ino of the Himi Fisheries Cooperative Association. “We can now catch fish in good condition regardless of the fishing methods used, thanks to the improvement of fishing equipment. We once damaged the fish as a result of fishing that focused solely on chasing shoals. Set net fishing puts no such burden on fish. Fishermen in Himi continue to treat yellowtails carefully even today, lifting them on their two palms.”

Set net fishing is a fishing method that has been practiced in many coastal parts of Japan for a long time. The fishermen in the respective regions have improved and developed this fishing method through information exchanges. A method developed in Himi spread to fishermen throughout Japan, beginning with the improvements made by the fishermen of Himi in around 1915 to a set net used in Miyazaki Prefecture. This method became known as Etchu set-net fishing after an old name for Toyama Prefecture.

Around forty-five set nets are erected in the ocean, 20 to 100 meters deep and two to four kilometers off the coast of Himi. Some of the large set nets are 700 meters long. The nets are set to catch migratory fish such as tuna, horse mackerel and mackerel, in addition to yellowtails. The fish can swim without difficulty in these large nets. Aside from the large ones, there are set nets in different shapes that take advantage of the habits of fish like sardines and squid that travel from the shore to the open sea. Including those, set nets account for 80% of fishing operations performed in Himi.

The haul of fish is falling year after year in Himi, however. In addition to the effects caused by climate change, indiscriminate offshore fishing using equipment like round haul nets is said to be a major cause of the decline.

“Set nets are distinctive in that fish can enter

and leave them freely,” explains Ino. “They also have a setup that allows some fish to escape when a large amount of them swim in. One study group made an investigation into fish and found that set nets catch only 20% of all fish that enter them, or 30% at the most.”

Set net fishing has been attracting growing interest around the world in recent years as a sustainable method of fishing that does not destroy an ecosystem or deplete the fish stocks living there. Set net fishing can save ship fuel and has a lower environmental load because it is performed in locations close to the shore.

Himi City sponsored the International Set Net Fishing summit in Himi jointly with Toyama Prefecture and the Fisheries Agency in 2002. About 1,300 government officials, researchers and people involved in fishing took part in the summit from thirty-five countries and regions, including Thailand, China and Costa Rica. Participants from overseas expressed their desire to adopt Etchu set-net fishing when this fishing method was introduced at the summit. In response, Himi City decided to dispatch researchers and fishermen overseas in cooperation with the Japan International Cooperation Agency. The researchers and fishermen dispatched by Himi City have provided technical guidance on set net fishing in Thailand and Indonesia so far.

“To practice set net fishing, you must inspect the nets every day,” points out Ino. “You need many years of experience and intuition as fishermen to adjust the nets. Set net fishing is relatively inefficient and achieving its spread might be difficult if we think only in industrial terms. But we are practicing set net fishing in order to hand on the sea where fish live to the next generation.”

Families in Himi have passed down a variety of fish cooking methods. They consider eating fish from head to tail without wasting any parts as a matter of course. The sustainable fishing method that does not burden fish has been maintained for 400 years in Himi because a culture of placing high value on fish has taken root among not only the fishermen, but also all the people in the area. 



The Project to Restore a Bountiful Sea

The government, private sector, NPOs, scholars and citizens have united to restore Osaka Bay to its former beautiful and bountiful state.

MAO FUJITA

OSAKA Bay is an enclosed coastal sea area situated at the eastern end of the Seto Inland Sea with two bay entrances, the Akashi and Kitan Straits. Distinct characteristics of the bay are a hinterland of mountains from 500 to 1,000 meters in height such as Mount Rokko and Mount Ikoma, and a vast catchment area into which many rivers flow.

Spanning seven prefectures, Osaka Bay is a focal point of population and industry and had long played a role as a location for industry, trade and fishing. Up until around 1955, the Bay was dotted with sandy beaches that locals enjoyed for bathing and clamming, which cultivated an intimate connection between people and the sea. However,

All photos: Courtesy of Osaka Bay Regeneration

during Japan's rapid economic growth period, land reclamation advanced along coastal areas as activity picked up in the region as a hub of distribution and production. As a result, natural beaches, seaweed beds and tidelands shrank or disappeared, developing a body of water in which seawater could more easily stagnate. Progress was also made in the development of shore protection facilities to safeguard the livelihoods of people in the surrounding area. As the population grew and industry developed in the closed-off section of the bay, sea pollution and waste increased, creating a compromised habitat for marine life.

In December 2001, the Office for Promotion of Regional Revitalization, Cabinet Office adopted "Sea Regeneration" as an urban regeneration project, and in July 2003, Osaka Bay Regeneration was established as a government-led effort to pursue environmental improvements to Osaka Bay. In the years since, Osaka Bay Regeneration has worked with many different organizations including citizens,

NPOs, scholars and companies to regenerate Osaka Bay by restoring sea conditions, addressing water pollution, and by making improvements to forests and the rivers that flow into Osaka Bay.

“Large factories had been built on many plots of reclaimed land around the closed-off sections of Osaka Bay, including an industrial zone for heavy and chemical industries, and we suppose that depressions scooped out of the seabed due to reclamation work and changing tidal streams from reclaimed land have had an effect on the environment in Osaka Bay, such as what we have seen with blue tides and red tides associated with poor oxygen water mass or eutrophication,” says Yoshiki Matsui, Senior Officer for Engineering Planning, Planning Department Office of the Ministry of Land, Infrastructure, Transport and Tourism, Kinki Regional Development Bureau.

Osaka Bay Regeneration has been pursuing initiatives to restore what was once a beautiful, familiar and bountiful Naniwa Sea (literally, “garden of fish”; “Naniwa” was the name given to the Osaka Bay area on account of its abundant marine life). The organization has three groups focused on land, sea and monitoring, and conducts a range of activities aimed at restoring the environment. The Sea Group concentrates on refilling seabed depressions, while the Land Group works on development of forest and sewage treatment facilities. The Monitoring Group conducts general surveys of water quality and living organisms to ascertain the effects of improvements, and conducts activities to understand the state of the environment in Osaka Bay.

“There are limits to what the government can do alone in restoring Osaka Bay. We need to gain understanding of residents in inland areas like Shiga and Kyoto prefectures that are in the hinterland zone of Osaka Bay. Rain that has fallen in inland areas and melting snow flows into Osaka Bay from Lake Biwa in Shiga prefecture along the Yodogawa River. Even for people living in regions that are not directly connected to Osaka Bay, it is important to have an awareness of the environmental protection that is

closely linked to daily activities, such as reducing waste volume and releasing clean water so as not to place a burden on the environment,” says Matsui.

With the aim of restoring the beautiful, familiar and plentiful sea and regenerating Osaka Bay into something citizens are proud of, Osaka Bay Regeneration is working on activities in coordination and cooperation with a wide range of entities that include industry, government and academia. For example, the organization holds forums and events for citizens to inform them of the condition of Osaka Bay, and as part of the citizen group-led Osaka Bay General Survey of Marine Life, 1,098 people from twenty-five groups have taken part in activities to ascertain the aquatic environment of Osaka Bay. The survey involves verifying the presence of various fish and shellfish, as well as a finless porpoise, a member of the dolphin family.

“It takes a lot of time and effort to return the sea to a fertile state. In order to pass on a beautiful sea to younger generations, government organizations are taking a leading role in innovative efforts to restore Osaka Bay,” says Matsui.

Osaka Bay Regeneration will continue to promote activities to restore Osaka Bay while incorporating people’s feedback on its efforts. 



Citizens conduct the Osaka Bay General Survey of Marine Life



Masters in Maritime Safety and Security

Japan provides a training and education program for officers of Asian coast guard agencies and is seeking international cooperation in a bid to ensure safety and security at sea in Asia.

HIROSHI SAKURAI

TANKERS and container ships carrying commodities, such as oil, foodstuffs and manufactured goods, travel back and forth through the sea lanes connecting the Middle East and Asia. These are vital routes, not only for Japan but also for the global economy. However, problems including piracy, smuggling, accidents at sea and environmental pollution are occurring in the waters through which these sea lanes pass. How to guarantee safety in the waters has become a major issue.

To solve these problems, Japan offers various

- 1 Students in the third Maritime Safety and Security Policy Program visit the Haneda Air Base of the JCG.
- 2 Students in the third Maritime Safety and Security Policy Program exchange opinions.
- 3 Students in the first Maritime Safety and Security Policy Program pay a courtesy call to Japanese Prime Minister Shinzo Abe (center) in September 2016.

Photos: Courtesy of Japan Coast Guard

forms of assistance to countries with coastlines in the waters concerned. For example, Japan provides countries such as Indonesia, Malaysia, the Philippines and Vietnam with patrol boats. In addition, the Japan International Cooperation Agency (JICA) and the Japan Coast Guard (JCG) work together to provide training related to the issues, including crackdowns on crimes at sea, disaster prevention and rescue, and hydrographical surveys, to the staff members of coast guard agencies in the respective countries, in Japan. They also dispatch JCG staff members to the respective countries as JICA experts in an attempt to help the coast guard agencies there build up their organization and provide the bodies with support in the area of personnel training.

JICA and the JCG began implementing the Maritime Safety and Security Policy Program in collaboration with the National Graduate Institute for Policy Studies (GRIPS) in 2015. This Program is a one-year master's course for junior coast guard officers from the JCG and coast guard agencies in the respective Asian countries. The Program is aimed at training personnel equipped with advanced practical and applied

knowledge related to maritime safety and security, analytical and problem-solving abilities, and international communications skills. At the same time, the Program promotes cooperation with the respective countries. A master's program for the junior officers of coast guard agencies is a rarity worldwide. In the past two completed Programs, the Master of Policy Studies has been awarded to a total of sixteen students in the Program who came from Japan, Indonesia, Malaysia, the Philippines and Vietnam.

The students study basic subjects, including international law of the sea, international security studies, and international relations, at GRIPS in Tokyo for the first six months. In the remaining six months, they take lessons more closely related to maritime safety and security practice, such as the policy for search and rescue, salvage and maritime disaster prevention and the maritime police policy at the Japan Coast Guard Academy in Hiroshima Prefecture. The students also write a policy paper equivalent to a master's thesis as part of the Program.

A range of cases on maritime safety and security, such as piracy and oil spills at sea, are taken up in a case-study lesson on maritime safety and security policy. The lesson places emphasis on the students thinking up solutions for the cases provided and discussing them with the other students.

"There were clashes of opinions among the students because each country has different religions, cultures and systems," remembers Hiroaki Onodera, Assistant Director for International Cooperation at the JCG, who took part in the first Program. "But our understanding of each other deepened through discussions and the experience of living together. Our training period is over, but we remain bound by strong ties as members of the same class."

A total of seven staff members from the JCG, the Philippine Coast Guard, the Malaysian Maritime Enforcement Agency, Marine Department Malaysia and the Sri Lanka Coast Guard (SLCG) are studying in the third Program, which commenced in October 2017.

Rajinda Daniel, one of the seven students, is in charge of coordinating coast guard units at the SLCG. Fishing and tourism take advantage of the

abundant marine resources that flourish on the coast of Sri Lanka. The waters are also an important marine transportation route. Japan has provided various forms of assistance to the SLCG, including the supply of patrol boats and technology transfers for protecting the marine environment.

Daniel says that oil spill response has improved dramatically in Sri Lanka thanks to training provided by the JCG related to the prevention of oil spills and how to respond to them. Daniel notes that he applied for the Maritime Safety and Security Policy Program because he was convinced that he could learn a lot of policies from Japan.

About six months have passed since Daniel arrived in Japan. He says that he is improving his skills in analyzing matters from an international perspective through information exchanges with fellow Program students from other countries, in addition to gaining knowledge about international law and learning ways of dealing with problems that occur at sea.

Daniel says that he plans to study search and rescue at sea, which is underdeveloped in Sri Lanka, as the theme of his policy paper, adding that he hopes to reflect the outcome of this study on his country's policies and disseminate the knowledge he has gained in Japan to a large number of his juniors after returning to Sri Lanka.

A network for a peaceful, safe sea is spreading across the waters in Asia. 



Hiroaki Onodera (right) of the JCG, who took part in the first Maritime Safety and Security Policy Program, with Rajinda Daniel, a staff member of the Sri Lanka Coast Guard (SLCG) who is participating in the third Program.

Photo: Hiroshi Sakurai



FURUNO's maritime electronics equipment fitted in the Holland America Line cruise ship MS Noordam

Fish Finders Point the Way for Future Fishing

Around seventy years ago, two Japanese brothers developed a device to detect the location of fish underwater using ultrasonic wave technology. Today their company's products are used around the world.

TAKASHI SASAKI

HEADQUARTERED in Nishinomiya City, Hyogo Prefecture, Furuno Electric Co., Ltd. (FURUNO) is a leading manufacturer of marine navigation and communications equipment with sales offices in more than eighty countries around the world. In 1938, FURUNO was launched as a small family-owned radio sales and repair shop in Kyushu's Nagasaki Prefecture. A major turning point in its growth came in 1948, when its founder succeeded in commercializing the world's first practical fish finder while undertaking the work of outfitting electronics on fish and cargo vessels.

"FURUNO's founder Kiyotaka Furuno (1920-2013) began developing a fish finder in 1945, when he acquired an ultrasonic wave detector that had been used by the military," says Yasushi Nishimori, PhD, Director and General Manager of the Research and Innovation Center at FURUNO. "In those days, it was a common view among academia that ultrasonic wave technology was only capable of determining the sea-bottom environment, and that it was not capable of detecting the location of swimming fish. One day in 1943, when Furuno was undertaking electric work on board a fishing vessel, a seasoned fisherman told him that bubbles floating on the surface of the sea are an indication of a good fishing spot. Greatly inspired by this tip, Furuno is said to have subsequently started developing the fish finder system. He probably thought that the ultrasonic wave

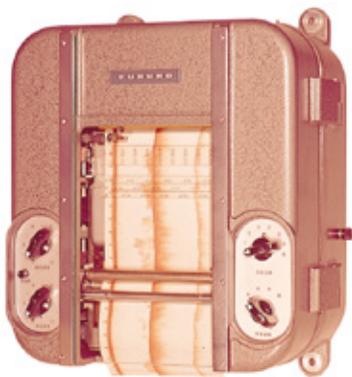
technology could be used to detect swimming fish because ultrasonic waves are capable of detecting reflected waves on the hard sea-bottom ground, as well as in the air."

After some trial and error, Kiyotaka succeeded in developing a technology that could determine the location of a school of fish by detecting the reflected waves in the air inside the air bladder of fish. He named this device the "Fish Finder," restructured his business to establish a new company together with his younger brother, Kiyokata, and launched comprehensive marketing activities for the fish finder. Initially the business was not successful because fishermen did not trust the system's performance or share the skills necessary to use the device widely.

In response, Kiyotaka sent Kiyokata to the Goto Islands in Nagasaki Prefecture as the chief fisherman working on a fishing vessel. Kiyokata succeeded in boosting the catch volume significantly by using the fish finder. Moreover, he was active when it came to sharing a range of feedback data from the fish finder with his fellow fishermen on board, and this helped the fish finder to rapidly gain popularity in the fishing industry. Subsequently, customer confidence in FURUNO rose, resulting in significant sales success.

"Initially, our fish finder was sold for 600,000 yen per unit, which was as expensive as a house in those days. Despite its high price, the company's technology attracted fishermen from all over the country. In fact, I heard that a number of customers in the fishing industry visited FURUNO (which was formerly based in Nagasaki City) with backpacks full of cash to

All photos: Courtesy of Furuno Electric Co., Ltd.



FURUNO's first Fish Finder featuring a data recorder (Model: F-261)

buy our fish finder," smiles Dr. Nishimori.

FURUNO has continued to make consistent efforts to improve its fish finder since it was

launched onto the market, announcing new products one after another, including radiotelephone equipment for fishing vessels and shipboard radars. In 1956, the company began exporting its products. Kiyotaka Furuno was a strong advocate of the hands-on approach to business, and this established the basis for the company's business approach of *genba-shugi*, which entails finding the seeds for new technologies and developing products based on customer needs by investigating things firsthand in the field. He often encouraged employees by saying, "Don't see yourself as a mechanical engineer; see yourself as a leading navigator."

"FURUNO has developed a range of unique marine electronics products, including the world's first tidal current meter and bird radars, as a result of our persistent efforts to meet the requests of customers in the fishing industry," says Dr. Nishimori.

Based on its sophisticated technology and expertise, FURUNO has expanded its product lines, including electronics equipment for large vessels and pleasure boats, medical equipment, disaster management systems, and intelligent transport systems. While FURUNO recognizes the importance of business diversification, the maritime industry is and will remain its core business area in the future.

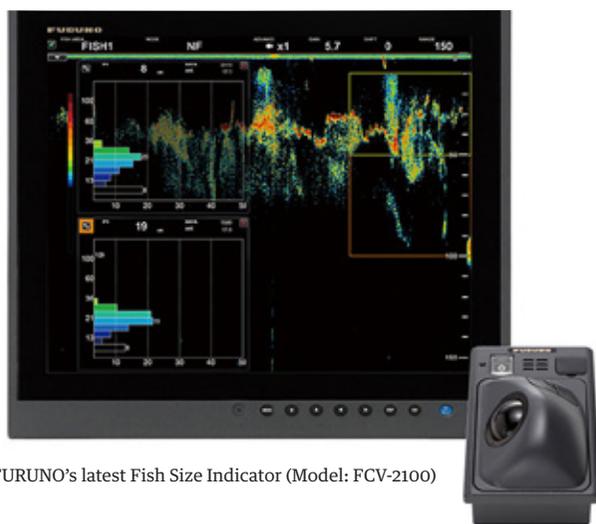
Dr. Nishimori says, "A top priority in our agenda for the future is the sustainable management of marine resources. Information regarding the types and volume of fish in terms of the total allowable catch currently relies on data gathered by research activities using research vessels. Those research data are used only as estimates because of the limited number of research vessels in operation, the sea

is relatively large. Given this situation, we have high expectations for an extensive set of data gathered by FURUNO's fish finders that are currently in operation all over the world."

Dr. Nishimori continues, "Analyzing different sets of data will make it possible for us to monitor and conserve marine resources more accurately. Recently, more countries around the world have been intensifying their efforts to sustain marine resources by setting strict fishing quotas in accordance with the size and species of fish.

"When we succeeded in commercializing the fish finder, our corporate mission was focused on contributing to society through activities for protecting food security. Going forward, global efforts involving Japan toward the appropriate control of marine resources will be seen as an important issue in our society," says Dr. Nishimori. "We take active steps to develop new types of fish finders to enable fishing operators around the world to have the ability of determining not only the size but also the species, such as herring and mackerel, as a social contribution."

FURUNO's technology has significantly changed the scope of the fishing industry, where it was usually necessary to rely on seasoned fishermen for their experience and intuition. The world is watching FURUNO as an innovative leader in protecting and developing marine resources for the future. 



FURUNO's latest Fish Size Indicator (Model: FCV-2100)



Fish-Loving Food Culture Refreshed

Consumption of fish has been declining in Japan in recent years, but one seafood dealer is nevertheless enjoying strong sales growth while promoting a variety of ways to enjoy eating fish.

HIROSHI SAKURAI

FISH and fishery products have comprised much of the Japanese diet for centuries, as the country is surrounded by the sea and blessed with a wealth of various marine products all year round. Seafood is processed by Japanese people using many different traditional recipes that include fermenting it to make *nare-zushi* (fermented sushi), which is believed to be the earliest form of today's sushi; drying and salting it to preserve the fish; and pureeing it to form fish cakes. Fish is served raw as sashimi or sushi, fried as in tempura, grilled, simmered and steamed, and it has played a

significant role as an ingredient in making Japanese food culture so rich and diverse.

After the Second World War, the consumption of fish and fishery products in Japan began growing as development of transportation distribution networks and household refrigerators made fresh marine products accessible to consumers living in the mountainous countryside as well. According to the White Paper on Fisheries published by the Fisheries Agency, the annual consumption of fish and fishery products per capita in Japan was 40.2 kg in FY2001. (The annual consumption of meat per capita in Japan was 27.8 kg in the same year.)

However, the domestic consumption of fish and fishery products peaked in FY2001 and declined

- 1 Fresh fillets of a wide variety of fish on display at Toshin Kitchen
- 2 Ready-to-eat meals of sautéed fish with vegetables in colorful, microwavable packs
- 3 Grab-and-go sushi dinners
- 4 A Toshin Kitchen staff member prepares to slice fresh marlin into portions

Photos: Courtesy of Toshin Sea Foods Co (1, 2); Yuichi Itabashi (3, 4)

steadily in the following years to a low of 25.8 kg in FY2015. The downward trend in the consumption of fish and fishery products could be attributable to factors such as food diversification, a reduction in domestic fishing capacity, and consumers' growing reluctance to take the time needed to prepare fish dishes, given the aging population along with an increase in the number of working families.

Despite the challenging trends in the market, Toshin Sea Foods Co. trades over 200 types of fish and fishery products a year and is enjoying strong sales growth. The company was founded in Ogikubo, Tokyo in 1949 and now operates thirty retail shops primarily in the Tokyo metropolitan area, offering a variety of opportunities for consumers to become familiar with fish and fishery products.

Nobutsune Orimo, President of Toshin Sea Foods Co., says, "People cook fish at home much less often than in the past because they do not know how to cook fish, or cooking fish takes up too much of their time. We are attempting to develop new fish products and related services in response to consumer needs as indicated by their reasons for not cooking fish at home."

Toshin Sea Foods Co. is not just a fish trader. It actively promotes opportunities for consumers to become familiar with the fun of eating fish and fishery products in pursuing quality of life. As part of its initiatives, the company opened Toshin Kitchen at its Ogikubo main store in 2014.

At seafood retailers, shop clerks do not usually tell their customers how to cook fish. At Toshin Kitchen, a professional chef gives cooking demonstrations three times a day (morning, afternoon and evening) in a fully equipped kitchen facility including a cooking heater, a microwave oven and a cooking counter.

The customers who visit Toshin Kitchen have different profiles and preferences depending on the time of day when they visit the facility. The chef tries to avoid redundancy in the dishes demonstrated during

the day by introducing fish dishes that originate not only from Japanese cuisine, but also from Italian and Chinese cuisine. For example, the chef introduces dishes for large, low-cost food for housewife customers who visit with their children in the afternoon, and easy-to-cook dishes for working families and single office workers who visit the facility in the evening.

"Toshin Kitchen offers easy-to-cook recipes for fish dishes that encourage our customers to cook fish at home. Our persistent efforts to overcome the stereotypical image that cooking fish is complicated have finally paid off, and we have succeeded in attracting more customers to visit our shops more often," says President Orimo.

Along with the activities carried out at Toshin Kitchen, the company has developed easy-to-prepare precooked fish products, offering packaged sushi and sashimi as well as ready-to-eat microwave meal products in all of its retail stores. The colors of the food trays have been changed from black or white to yellow, blue or pink, as the colorful food packages were well received by customers, who say the dish on the table looks delicious and cheerful.

The company focuses on human resources development initiatives, and actively hires women and foreign nationals. In January 2018, the company hired ten trainees from Vietnam for the first time. The Vietnamese trainees have acquired hands-on skills in filleting, cooking and selling fish and fishery products. They now work in retail stores. The company plans to hire around ten trainees from Vietnam every year.

"We would like to pass Japanese cultural traditions and skills regarding fish onto the trainees. I hope that they will contribute to enriching their food culture when they are back in Vietnam, leveraging the skills and expertise in fish that they have acquired in Japan," Orimo says.

Japan is not the only fish-loving country in the world of course. Toshin Sea Food Co. hopes that its initiatives will be helpful in enabling the Japanese food culture to be passed onto the next generation both in Japan and abroad, enriching fish-loving food cultures around the world in many ways. 

The Sacred Island of Okinoshima

From the latter half of the fourth century up until the present day, the sacred island of Okinoshima has attracted the devotion of the seafaring people of the region, and has been protected as an object of worship.

KUMIKO SATO

OKINOSHIMA is a remote island in the Genkai Sea, roughly 60 km off the coast of Munakata City, in Fukuoka Prefecture. The people of the Munakata region call Okinoshima “*kami yadoru shima*,” meaning “sacred island” (or literally, “island where god dwells”). For a period of roughly 500 years, from around the latter half of the fourth century, large-scale religious rituals were conducted on the island. It has been carefully protected to this day as an object of worship; a sacred island that people are not readily allowed to approach. It is because of this that untouched primeval forests and the remnants of ancient ritual sites remain on the island to this day.

According to Japanese mythological documents compiled at the beginning of the eighth century, three goddesses—born as daughters to Amaterasu-omikami (the sun goddess)—are enshrined, respectively, at the ritual sites of Okitsu-miya on Okinoshima, Nakatsu-miya on the island of Oshima, and Hetsu-miya in mainland Munakata City, connected to Okinoshima and Oshima by a straight line across the ocean. Together these sites formed a wide-ranging place of oceanic worship which

eventually evolved into the Munakata Taisha (Grand Shrine) of today.

The worship of Okinoshima developed into the worship of the Three Goddesses of Munakata under the family, and that governed over their worship and the navigation of the Genkai Sea during those ancient times, was the powerful Munakata clan. The tombs of the Munakata clan can be seen today in the Shimbaru-Nuyama Mounded Tomb Group, in the neighboring city of Fukutsu. In July 2017, the Sacred Island of Okinoshima and Associated Sites in the Munakata Region (including these ancient tombs) were added to the UNESCO World Heritage List.

“We know that the people of the ancient kingdom of Yamato engaged in interactions with other countries in East Asia via sea routes across the Genkai Sea. When doing so they used Okinoshima as a kind of seafarer’s guidepost. The island also has fresh water, so they could use it as a place of refuge, to keep them alive when seas were rough. For reasons such as this, Okinoshima was an important island for ancient mariners, which was fraught with danger, and so it was probably because of this that it eventually came to be deified,” says Hirokazu Ohtaka, Senior Technical Staff in the Fukuoka Prefectural Government’s World Heritage Registration Promotion Office.

The Munakata clan also prospered by engaging in trade with overseas countries during the Middle Ages, and despite the discontinuation of the clan at the end of the sixteenth century, people in the region still continued to worship the Three Goddesses of Munakata.

All photos: Courtesy of the Sacred Island of Okinoshima and Associated Sites in the Munakata Region



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- 1 The Sacred Island of Okinoshima and Associated Sites in the Munakata Region
- 2 Okitsu-miya Yohaisho, Munakata Taisha: Tangible evidence for the living tradition of worshipping Okinoshima from afar
- 3 Nakatsu-miya, Munakata Taisha: A place of worship on the island of Oshima
- 4 Shimbaru-Nuyama Mounded Tomb Group: Evidence related to the people of Munakata who performed religious rituals on Okinoshima in their role as key supervisors of overseas exchanges.
- 5 A gold ring (Shimpokan Museum, Munakata Taisha collection)
- 6 Gilt-bronze dragon heads (Shimpokan Museum, Munakata Taisha collection)

Although fishermen sometimes visit the port of Okinoshima, they do not enter the deeper parts of the island itself, and even priests entering the island to conduct religious rituals must first disrobe and purify their bodies in the ocean, in a ritual of purification known as *misogi*. Okinoshima has been protected by a set of strictly observed, unwritten taboos that forbid actions such as removing anything—even a single stone or blade of grass—from the island, or divulging anything seen or heard there.

While the sacred island of Okinoshima had been secretly protected by the people of the region, from around the 1940s momentum heightened for the restoration of Okinoshima, and surveys were started to clarify the island's history. Three academic surveys were conducted from 1954 onwards, leading to the discovery of twenty-two ritual sites and an enormous amount of votive offerings also being unearthed; a wealth of historical evidence emerging from the world of myth and legend. In addition to items such as bronze mirrors, comma-shaped beads, gilt-bronze harnesses and pure gold rings, there were also shards of glass presumably brought to Japan by way of the distant Silk Road. Approximately 80,000 precious and lavish items discovered on the island have now been designated as Japanese national treasures.

At the same time as this, numerous rituals that were carried out at Munakata Taisha during the middle ages were also revived. The Grand Autumn Festival, in particular, is an important festival in which the Three Goddesses of Munakata come together at Hetsu-miya. At the Miare Festival held on October 1

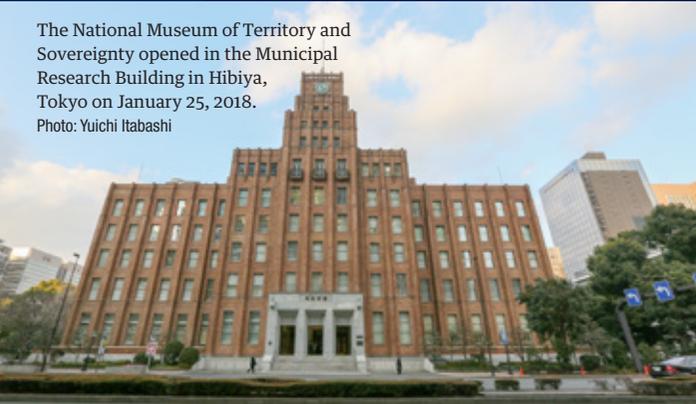
of each year, hundreds of fishing boats from seven bays in Munakata fly *tairyō-bata* (flags signifying a large catch of fish) and come out to escort two *gozabune* ships carrying *mikoshi* portable shrines from Okitsu-miya and Nakatsu-miya to the mainland. It is a magnificent and unparalleled maritime ritual.

Over the course of three days of the Grand Autumn Festival, until its closing with the Kannabi Festival (which takes place at Takamiya Saijo, which was Hetsu-miya's ancient place of ritual), various displays of ritual performances such as *yabusame* (horseback archery) and *kagura-mai* (a type of dance) are given, and the grounds of Munakata Taisha bustle with large numbers of visitors.

“Although the shape and form of worship has changed with the times, the island of Okinoshima itself is still worshipped today as a deity. This originates from the fact that the starting point for Japanese religious beliefs was in nature worship,” says Ohtaka.

Worship of the Three Goddesses of Munakata, praying for safe voyages across the seas, spread widely across the whole of Japan. The Three Goddesses of Munakata are also the enshrined deities at other significant Shinto shrines including Itsukushima Shrine, in Hatsukaichi City in Hiroshima Prefecture (which was an important strategic location for shipping and maritime trade), and Enoshima Shrine, in Fujisawa City in Kanagawa Prefecture. Even today, people continue to pray for the well-being of seafaring people, and to express their feelings of awe and reverence towards nature. 

The National Museum of Territory and Sovereignty opened in the Municipal Research Building in Hibiya, Tokyo on January 25, 2018.
Photo: Yuichi Itabashi



Takeshima and the Senkaku Islands

On January 25, 2018, the National Museum of Territory and Sovereignty opened in a corner of Hibiya Park, Tokyo. The museum displays documents and materials related to Takeshima and the Senkaku Islands.

HITOSHI CHIBA

THE National Museum of Territory and Sovereignty is the first permanent facility of its kind set up by the Government, and visitors can see various documents and materials which indicate the fact that Takeshima, part of Okinoshima-Town in Shimane Prefecture, and the Senkaku Islands, part of Ishigaki City in Okinawa Prefecture, are inherent territory of Japan. While the tension over the Japanese territory has been increasing, the Museum is positioned as a hub to diffuse accurate understanding concerning the territory and sovereignty of Japan across the world.

Here we share some remarks from experts regarding Takeshima and the Senkaku Islands.

Takashi Tsukamoto

Professor, Department of Law, Tokai University

In the 17th century, townsmen from present-day Yonago City in Tottori Prefecture engaged in fishing and hunting at Utsuryo Island in the Sea of Japan and Takeshima, which was on the way to Utsuryo Island,

under the approval of the Government (the Edo shogunate). While the shogunate banned passage to Utsuryo Island in the 1690s as a result of negotiations between Japan and Korea over abalone fishing on the island, no such ban was issued for Takeshima.

Due to an emerging need to regulate sea lion hunting in the early 20th century, in 1905 the Government incorporated Takeshima into Shimane Prefecture. The Government registered Takeshima as a state land, and revised and applied fisheries regulations, thus, exercised its sovereignty over Takeshima peacefully and continuously. In this way, Japan authenticated the sovereignty over Takeshima in accordance with the modern international law.

After the Second World War, Korea demanded the United States, which was preparing the draft of the Treaty of Peace with Japan, to designate Takeshima as Korean territory. The United States, however, denied the Korean territory (in July 1951) by the reason that Takeshima was never treated as part of Korea and the island had been under the jurisdiction of Shimane Prefecture since about 1905. As a result, in the San Francisco Peace Treaty (signed in September 1951), Takeshima was affirmed as a



From the left: Entrance of the Museum; Museum interior; Touch panel and map showing the islands of Takeshima and Senkaku; Historical documents of Takeshima; Pamphlets for Senkaku and Takeshima; Historical documents of Senkaku Photos: Yuichi Itabashi



Professor Takashi Tsukamoto
Photo: Tadashi Aizawa

territory of Japan. However, on January 18, 1952, just before the treaty took effect, Korea unilaterally drew a line in the high sea, in contravention of international law, and encompassed Takeshima. On January 28, 1952, Japan launched a protest against

Korea. Although Korea continued to accumulate fait accompli such as stationing armed personnel on Takeshima (starting in 1954) and a construction of a lighthouse, all of these Korean actions were taken after the generation of this dispute. Therefore, they do not constitute a basis of the territorial claims.

Japan has proposed to refer this case to the International Court of Justice three times, but Korea has rejected all of the proposals. The dispute should be resolved not by force, but on the basis of law. It is an exemplification of mature international society.

Kurayoshi Takara

Emeritus Professor, University of the Ryukyus

It is important to understand the Senkaku Islands based on history.

From the birth of the Ryukyu Kingdom in 1372 to abolishment of its *sakuhō* (tributary) relationship with the Qing Dynasty in 1876, the Ryukyu Kingdom engaged in so-called tributary trade with China's Ming and Qing Dynasties. Making twice-yearly return trips to Fuzhou, China, Ryukyuan were familiar with the Senkaku Islands which laid on the sea route between Ryukyu and Fuzhou. However, the Ryukyu Kingdom's administration did not extend to the Senkaku Islands. This is because, while

the Ryukyu Kingdom at the time governed over remote islands through the Shuri royal government, the Senkaku Islands were uninhabited and there was no need to extend administrative acts there. Needless to say, the Senkaku Islands were not controlled by any other nations.

In 1885, Okinawa Prefecture dispatched survey teams to the Daito Islands and Senkaku Islands for the purpose of developing uninhabited islands, and, at first, placed the Daito Islands under the jurisdiction of Okinawa Prefecture. After careful survey on the Senkaku Islands, the Government placed them under the jurisdiction of Okinawa Prefecture 10 years later on January 14, 1895. In 1900, pioneers from Hachijojima Island moved to the Daito Islands and started development mainly by the cultivation of sugar cane, then they settled down in the islands. In 1896, the development of the Senkaku Islands was started by Tatsushiro Koga, a businessperson from Fukuoka Prefecture, mainly by the fishing industry.

It is important also for the context of international law to conduct working for finding out the three-dimensional facts by these kind of historical reasons and the accumulated facts. The National Museum of Territory and Sovereignty is a key facility to take the role of displaying the results of the research of documents. The facility will be the place of highlighting the importance of “fact-based knowledge” and “objective discussion.” It is important to share Japan's position and grounds for argument with the Japanese people as well as the international community in this way. ㊦



Professor Kurayoshi Takara
Photo: Yuichi Itabashi



SELF-HEALING CERAMICS FOR MULTIPLE APPLICATIONS

A Japanese research team has developed a new approach to self-healing ceramic design that paves the way for structural ceramics' use in a much wider range of fields, including turbine blades in aircraft engines.

TAKASHI SASAKI

THERE are materials that have so-called self-healing properties. When a crack forms in a component, it triggers a chemical reaction, and the material repairs the damage itself. In December 2017, a new type of self-healing ceramic was unveiled for use in aircraft engines. The new material in question was jointly developed by Yokohama National University (YNU), which has been involved in materials research, and the National Institute for Materials Science (NIMS), as part of a Japan Science and Technology Agency (JST) Advanced Low Carbon Technology Research and Development Program (ALCA).

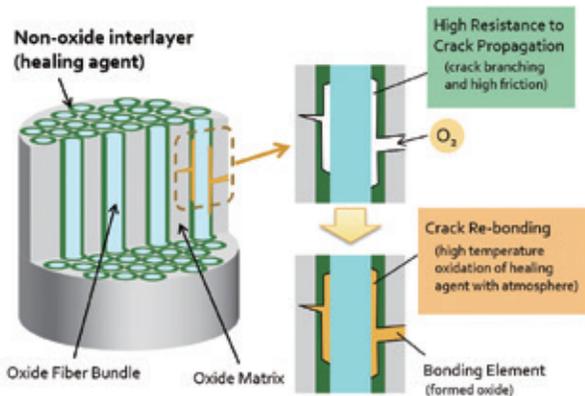
“A research group at YNU discovered self-healing ceramics in 1995,” explains Professor Wataru Nakao from the YNU Graduate School of Engineering. “Although the phenomenon whereby a material can repair itself had been discovered several decades earlier, researchers often overlooked it because so many aspects of self-healing mechanisms were still unexplained back then. The fact

that healing only occurred within a limited temperature range around 1,200°C meanwhile meant that research and development was a process of trial and error initially.”

As we entered the twenty-first century, research into ways of using self-healing ceramics in products began to gather pace. Research into self-healing materials now spans various different fields, including polymeric materials and concrete.

“In the simplest possible terms, a self-healing material is an artificial material that has built-in capabilities similar to the human metabolism,” continues Nakao. “When cracks form in ceramics, oxygen gets in and causes an oxidation reaction. Over time, the heat produced by this reaction and oxide generation cause the material to expand in volume, which in turn rejoins the surface of the crack. This phenomenon is very similar to the healing process in bones, whereby inflammation and heat in the initial recovery period give way to a modification period as the bone is restored to its original state. The network of fluids inside the body, which stimulates the human metabolism, provided us with useful pointers when it came to developing self-healing ceramics. That was the

Oxidation Reaction



key to working out how to incorporate self-healing materials into ceramics.”

Used at 1,000°C, equivalent to the temperature of the exhaust from a jet engine, the newly developed self-healing ceramic is able to completely repair damage in as little as one minute. Given that a conventional material would take around 1,000 hours to repair itself, this represents a giant leap forwards. At present, the turbine blades in aircraft engines contain components made from alloys. If these parts could be replaced with lightweight and heat-resistant ceramics, that would translate into a projected improvement in fuel efficiency of around 15%. That is why these new materials are attracting a great deal of attention from all over the world.

“Aircraft components have to meet countless criteria for international standards and certification,” comments Nakao. “We are looking at commercialization at some point from 2030 onwards, with the aim of fitting products to the first domestically produced jet engine.”

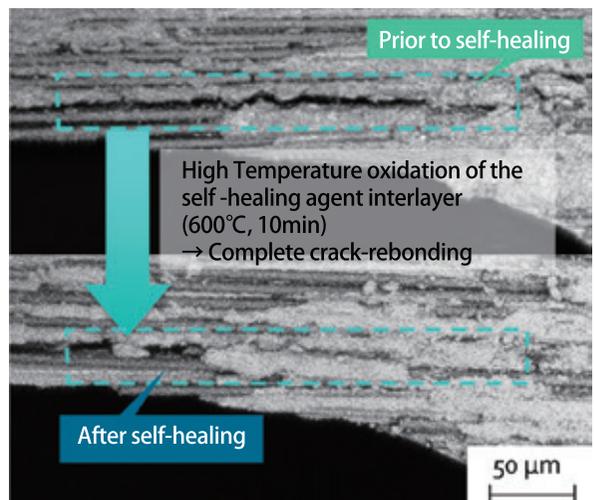
The fact that this new ceramic exhibits self-healing properties from a temperature range of around 400°C opens up potential applications across a whole host of industries, in addition to aircraft.

“Ceramics can be used for a wide range of purposes, because they are light and highly heat

resistant,” explains Nakao. “The self-healing ceramic we have developed here could be used for contacts in automotive engines or electrical products, for example, or as a coating material. It could have even more of an impact if it were able to be used in components for satellites, or in other locations where maintenance is difficult.”

The main benefits of self-healing ceramics are that components have a longer life span and do not require maintenance. Professor Nakao and his research group are nonetheless continuing to carry out research to expand the possibilities even further.

“If we can control how components degrade, and improve self-repair capabilities, we will be able to produce materials that become stronger and more functional as they continue to heal themselves over time. This is the same principle as broken bones, which become stronger once the injury is healed. It’s also similar to items such as traditional Japanese lacquerware, or wooden structures, which increase in strength with use over many years, and improve in usability as time passes.”



Japan is a world leader when it comes to ceramic firing technology. There are high hopes that the continuing development of self-healing ceramic technology will open up new possibilities for safety and security.



Jellyfish and Haiku

Dhugal Lindsay stands in front of JAMSTEC's SHINKAI 6500 manned submersible.
Courtesy of Dhugal Lindsay

An Australian marine researcher is making discoveries in the waters off Japan while breathing new life into the world of haiku.

KUMIKO SATO

AUSTRALIAN Dhugal J. Lindsay, PhD belongs to the Research and Development Center for Submarine Resources under the Japan Agency for Marine-Earth Science and Technology (JAMSTEC), where he studies marine organisms and works on equipment development.

Born and raised in Rockhampton near the Great Barrier Reef, a UNESCO World Heritage site, Lindsay says he always felt a connection with Japan because many Japanese tourists visited his hometown and a Japanese

exchange student attended his senior high school. Lindsay went to the University of Queensland (UQ), where he majored in science. However, he chose to spend a year abroad studying the Japanese language at a Japanese university.

Lindsay recalls his surprise that Japanese universities that offered a course on oceanography all had their own oceanographic research vessel. It occurred to him that a Japanese university would enable him to study marine organisms, his passion, in depth.

After graduating from UQ in

1992, Lindsay entered the graduate school at the University of Tokyo, studying marine organisms, and earned his doctorate. He joined JAMSTEC in 1997 and began deep-sea investigations around the world.

Jellyfish became Lindsay's specialty, growing fond of them



Aka chochin kurage (*Pandea rubra*), a jellyfish named by Lindsay
Courtesy of JAMSTEC/ photo by: Dhugal Lindsay

Lindsay stretches out next to a giant medusa *Stygiomedusa*, a species he named “*dai-o kurage*” (Emperor jellyfish)
Courtesy of Dhugal Lindsay



having wondered about their great diversity all over the world. He spends two to three months at sea each year, studying jellyfish sometimes by diving into the ocean in a manned research submersible.

The ecology of jellyfish is very mysterious and many things remain unclear. Some species of jellyfish live at the bottom of the ocean, while others float in the water. Tiny species can measure about 5 millimeters, but large ones can be up to 40 meters in length. They are not limited to sexual reproduction. Some species can breed independently; others proliferate by changing their form to anemone-like polyps on the ocean floor. Jellyfish occur under all kinds of environmental conditions and are highly diverse. Counting only species that float in the water, there are over 1,000 species. Lindsay is discovering new species one after another in his research.

The discoverer of any new species has the right to give it an official scientific name and, if they understand Japanese, a Japanese name. Lindsay has discovered many jellyfish, and gave Japanese names to the giant medusa *Stygiomedusa*, “*dai-o kurage*” (Emperor jellyfish), and to *Pandea rubra*, a species with a red lantern-like form, “*aka chochin kurage*” (red paper lantern jellyfish).

Lindsay is also a master haiku poet. His Japanese vocabulary may be larger than that of an average Japanese person, and his haiku skills are so distinguished that a major newspaper

appointed him to select contributions to its haiku page from those submitted from overseas.

Recently, people abroad have begun composing haiku in many languages. However, Lindsay writes his haiku in Japanese. It started with his homestay during university. He lived with a family where one member happened to be the haiku poet Yoko Sugawa.

Lindsay says that “*saijiki*,” a catalog of the season-specific words necessary for composing haiku, surprises him with the many words associated with nature in Japan. Citing the beautiful word *hikobae*, used to describe little buds that grow from a tree stump, he points out that there is even a Japanese verb, *hikobayuru*, that stems from it. Calling those words amazing, he notes the depth of the Japanese language.

Lindsay is scheduled to give a lecture at a national contest for haiku about the ocean to be held in Fukushima Prefecture in July 2018. He plans to discuss marine organisms, citing examples of gaps between their real ecology and people’s understanding of them.

Lindsay notes that relatively few haiku in Japan are written about marine organisms, and says

he wants people in Japan to learn more about marine organisms and to compose haiku about them because Japan is surrounded by the ocean. Lindsay adds that it would be wonderful if he could eventually compile an “*umi-no saijiki*,” a catalog of season-specific words about the ocean used for composing haiku.

As a matter of course, marine organisms appear in many of his haiku.

*Umihebi no
nagaki hitoiki
tsuyu ni iru*

the sea snake
takes a long, long breath
rainy season starts

Sea snakes, the lungs of which occupy 80% of their body length, take extremely long and loud breaths. This haiku could only have been composed by a marine biologist.

Haiku are short poems composed by confronting the beauty or mystery of nature. Lindsay is working to discover the depths of jellyfish and haiku through exploring the ocean, the object of his affections. ▮

KASUTERA: A SIMPLE YET SUBTLE SWEET TREAT

Though still inextricably linked with Nagasaki in the Kyushu region, the sponge cake *kasutera* is a firm favorite across Japan – and with people of all ages.

ROB GILHOOLY



TAIZO Fuchuya whips the whites of two dozen eggs in a large steel container while holding a pan of boiling water underneath. In the cooler months, he says, this helps to enhance the whipping process, a process known as *betsudate-ho* (“separated whipping method”) that is crucial to the making of his product, but is, by his own admission, no piece of cake.

“A lot depends on this stage of the process, which can be affected greatly by temperature, the seasons and the weather,” explains Fuchuya, 68, whose Castella Nakaya in downtown Tokyo specializes in *kasutera* and has been in operation for over a century. “I’ve been making these for forty-five years, and I still worry if it will come out OK.”

Rather than the decorative flour-and-cream-based cakes and gateaux found in the West, Japan is better known for *wagashi* (Japanese sweets) (see HJ June 2017, pp. 28-29), the most representative of which are made from *kanten* (agar), or a glutinous rice called *mochi* and are often paired with a paste made from sweetened azuki beans.

One notable exception is *kasutera*, or in its non-transliterated form, Castella, whose apparent simplicity belies a surprisingly nuanced and difficult to perfect dessert. It is also Japan’s oldest sponge cake, even though its origins are not found in Japan.

It is widely held that *kasutera* was first introduced to Japan in the sixteenth century by Portuguese merchants during Japan’s so-called *Nanban boeki*



Taizo Fuchuya has been making and selling kasutera at Castella Nakaya in Tokyo for forty-five years.



(Japanese trade with Spain and Portugal) period, following the opening of the port in Nagasaki, which was then a tiny fishing village in Kyushu, but is today a city of 400,000 people with which the cake remains inextricably linked.

Legend has it that when asked by locals what the cake was, Portuguese merchants referred to it as “Bolo (dessert) de Castilla” or “Pao (bread) de Castilla” – Castilla being the Portuguese word for Castile, a former kingdom on the Iberian Peninsula that continues to exist, albeit unofficially, as a roughly defined region in Spain that encompasses Leon, La Mancha and Madrid.

According to the book *Nanban boeki to kasutera* (Nanban trade and kasutera), published by Fukusaya, a 400-year-old kasutera maker in Nagasaki, one explanation for the roots of this “Bolo” or “Pao” can be found in a hard bread, or “biscuit” known in Spain as “bizcocho.” This started off primarily as a subsistence food for the Spanish Navy around 1,000 years ago, but also spawned a variant that is closer in consistency to the kasutera we know today, says the book.

Another connection linking Nagasaki kasutera and bizcocho can be found in the meaning of the Castilian word – “bake twice.”

According to Fuchuya, kasutera, too, requires two bakings: the first to give the cake its familiar deep brown top and bottom; the second to make the mixture rise.

The ingredients of that mixture are relatively straightforward. Once the egg whites are mixed to an adequately fluffy consistency, the yolks are added followed by three different types of sugar – *zarametou* (course ground), castor and *mizume* (a starch-based sweetener) – and, finally, flour.

This is baked in an oven heated to around 200°C for approximately 5 minutes before being baked again at a lower heat to complete the rising process. It is then left overnight, not just to cool but to draw out the characteristic flavors of the cake, according to Fuchuya.

“Fresh out of the oven, it actually doesn’t taste so great,” he says as he dons a pair of well-used oven gloves and takes a peek inside the oven at his creation, which is baked inside an oven-paper lined wooden frame about the size of a large chess board. “Allowing it to rest overnight returns the sweetness and deepens the flavor.”

That depth and sweetness is augmented by the use of the *zarametou*, which Fuchuya says is responsible for the wonderfully grainy, caramelly sensation that hits the tongue from the bottom of the cake.

“The biggest appeal of kasutera is its simple, but subtle taste that can be enjoyed by people of all ages,” says a customer at Castella Nakaya.

Today kasutera can be found even outside Japan, gaining a popular following in Asian countries such as Taiwan, Singapore and Indonesia. There are even kasutera shops in Portugal that have opened up over the past couple of decades. Introduced by Portuguese merchants centuries ago and now all-powerful in Japan, the day may soon arrive when kasutera delights taste buds around the world. **7**

Land of Mountains, Forests, Valleys and Caves

Chichibu-Tama-Kai National Park, which straddles Saitama, Tokyo, Yamanashi and Nagano Prefectures and is about 70 kilometers wide from east to west and about 40 kilometers long from north to south, is the closest mountain park of forests and valleys to the Greater Tokyo Metropolitan area.

KENTARO SANO

CHICHIBU-TAMA-KAI National Park features mountains and valleys, including the Okuchichibu Mountains that include high mountains 2,000 meters above sea level, such as Mt. Kimpu, Mt. Kobushigatake and Mt. Kumotori where Mt. Kita-okusenjodake (2,601 meters) is the highest peak, and the surrounding Mt. Daibosatsu, Mt. Ryokami, the Mitake-Shosenkyo Gorge and Okutama. Chichibu-Tama-Kai National Park is also characterized by the absence of volcanoes, although it is in a mountainous area, which is unusual in Japan. The Okuchichibu Mountains make up the headwaters and watershed of major rivers in the Kanto district and in the middle of the main island of Japan, including the Chikuma River (Shinano River), the Fuefuki River (Fuji River), the Tamagawa River and the Arakawa River. Due to the erosion of these rivers, steep V-shaped valleys have developed in the park and steep but beautiful and varied landscapes are visible. Of all the national parks, Chichibu-Tama-Kai National

Park is the closest to the Greater Tokyo Metropolitan area. It attracts about 14 million visitors who enjoy contact with nature throughout the year.

From Tokyo Station, it takes around two hours to get to Hatonosu Station, which is close to Hatonosu Gorge, a spot on the eastern side of the park. The valley is about ten minutes' walk from the station. Huge rocks and strange-looking rocks that were eroded by river currents spread to Lake Shiromaru, a dam lake 500 meters ahead. This area is known as a beautiful spot for maples. The view from Hatonosu Kobashi Bridge, a suspension bridge that overlooks the valleys, is particularly spectacular, and it is a popular spot.

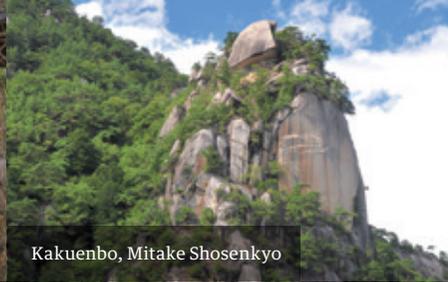
The front shrine (Haiden) of Mitsumine Shrine



The center of worship at Mitsumine Shrine is wolves.



Tochimoto Barrier



Kakuenbo, Mitake Shosenkyo

Most of the eastern side of the park is a sedimentary rock area that includes strata of limestone and is dotted with limestone caves. In particular, Nippara Limestone Cave is renowned as the largest limestone cave in the Kanto district. This limestone cave is 1,270 meters in total extension and 134 meters in altitude difference. A 40-minute tour of the inside of the limestone cave leads you to a fantastic space with stalagmites and stone pillars. The inside of the limestone cave is colorfully illuminated, and a water harp pot¹ using water that drops from the ceiling imbues it with even more mysterious charm.

In the middle and north of the park is Mitsumine Shrine, which is known as a shrine for worshipping mountains. The center of the worship is wolves, which are familiar spirits for the gods of the shrine, and wolves became the object of worship as Oinusama to the general public. The guardian god of general shrines is Komainu, a pair of stone-carved guardian dogs, whereas wolves are the guardians of Mitsumine Shrine, and wolves are enshrined in many locations in the shrine. The decorations of the main shrine (Honden) and the front shrine (Haiden) that stand in the precinct of the shrine are particularly beautiful. The main shrine hall, which was built in 1661, features copper roofing with Japanese lacquer and gorgeous colors. The front shrine of the shrine, which was built in 1800 and refurbished in 1962, features a coffered ceiling inside that depicts pictures of one hundred and several dozen varieties of flowers and trees in Okuchichibu and other colorful openwork.

On the western side of Mitsumine Shrine are the headwaters of the Arakawa River, which flows into Tokyo Bay. On the steep V-shaped valleys that were eroded by river currents are key points that connected the main roads in the Edo period (1603-1867), and Tochimoto Barrier used to be located there. This barrier played the role of securing against invasions prior to the Edo period and in keeping guard over the

inflows and outflows of people and guns during the Edo period. The barrier completed its role in the Meiji period (1868-1912), but residences that were built in the late Edo period and were left within the grounds of what used to be the barrier were designated as historic sites, Places of Scenic Beauty and natural monuments in 1970 as representative of the characteristics of the houses of officials who took charge of services for the barrier. In addition, the private houses scattered over the slopes of the valleys in front of what used to be the barrier are so beautiful that they are reminiscent of the scenery in the Edo period.

Mitake-Shosenkyo Gorge, which is located in the southwesternmost part of the park, is known as a place of scenic beauty that is representative of the park. It is said to feature the greatest scenic beauty in Japan and was designated as a particularly important Special Place of Scenic Beauty among all historic sites, places of scenic beauty and natural monuments designated by the central government in 1953. Kakuenbo, which is the symbol of Mitake-Shosenkyo Gorge, is a huge rock about 180 meters tall that rises almost vertically from the water surface in the valley, and its shining white cliffs are highlighted even more by green pine trees in summer and red and yellow maples in fall. The clear stream that spreads about 5 kilometers from the Sengataki Falls at the foothills to the Nagatoro Bridge constantly shows beautiful scenes, making even rain and snow look beautiful in combination with the strange-looking rocks and huge rocks in the neighboring area and the colorful trees throughout the seasons.

Mitake-Shosenkyo Gorge has attracted numerous painters since the Edo period, and is depicted in many famous paintings. Chichibu-Tama-Kai National Park is full of such attractions, inducing visitors to post pictures of local and delicious foods served within the park as travel stories on social media, in addition to the beautiful scenery. 

¹ This is a type of Japanese garden ornament that was invented in the Edo period (1603-1867). You can enjoy the echoes of the sound of water drops that drop into a hollow bowl buried underground close to a water bowl. Please see page 24-25, February, Highlighting JAPAN. https://www.gov-online.go.jp/eng/publicity/book/hlj/html/201802/201802_10_en.html



The Amanohashidate sandbar (left) in Miyazu Bay, viewed in the spring from one of the surrounding mountains

*spring sea — all day,
light waves
upon waves*

*Haiku by Yosa Buson;
translated by Herbert Jonsson*

HAIKU

The Spring Sea

Haru no umi

In this haiku by Yosa Buson (1716–1784), the great poet and painter captures the tranquility of a spring day spent gazing out at the sea. Buson is thought to have written the haiku when living close to Miyazu Bay in Kyoto Prefecture, a scenic spot famed for the long pine-covered sandbar that spans the bay. Perhaps Buson took in the view from one of the surrounding mountains, leant back against a cherry tree. Basking in the warm weather, he seems to have become hypnotized by the relentless sweep of the incoming waves and subsumed by the ambient spring haze.

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